SEQUENCE LISTING

<110> Jaworski, Jan G.
Post-Beittenmiller, Martha A.
Todd, James

<120> FATTY ACID ELONGASES

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<141> 1997-06-03

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<211> 520
<212> PRT
<213> Arabidopsis thaliana

<400> 2

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Val Lys Leu Lys Tyr Val Lys Leu Gly Leu His Asn Ser Cys Asn Val
        35                  40                  45
Thr Thr Ile Leu Phe Phe Leu Ile Ile Leu Pro Leu Thr Gly Thr Val
    50                  55                  60
Leu Val Gln Leu Thr Gly Leu Thr Phe Asp Thr Phe Ser Glu Leu Trp
65                  70                  75                  80
Ser Asn Gln Ala Val Gln Leu Asp Thr Ala Thr Arg Leu Thr Cys Leu
                85                  90                  95
Val Phe Leu Ser Phe Val Leu Thr Leu Tyr Val Ala Asn Arg Ser Lys
            100                 105                 110
Pro Val Tyr Leu Val Asp Phe Ser Cys Tyr Lys Pro Glu Asp Glu Arg
        115                 120                 125
Lys Ile Ser Val Asp Ser Phe Leu Thr Met Thr Glu Glu Asn Gly Ser
    130                 135                 140
Phe Thr Asp Asp Thr Val Gln Phe Gln Gln Arg Ile Ser Asn Arg Ala
145                 150                 155                 160
Gly Leu Gly Asp Glu Thr Tyr Leu Pro Arg Gly Ile Thr Ser Thr Pro
                165                 170                 175
Pro Lys Leu Asn Met Ser Glu Ala Arg Ala Glu Ala Glu Ala Val Met
            180                 185                 190
Phe Gly Ala Leu Asp Ser Leu Phe Glu Lys Thr Gly Ile Lys Pro Ala
        195                 200                 205
Glu Val Gly Ile Leu Ile Val Asn Cys Ser Leu Phe Asn Pro Thr Pro
    210                 215                 220
Ser Leu Ser Ala Met Ile Val Asn His Tyr Lys Met Arg Glu Asp Ile
225                 230                 235                 240
Lys Ser Tyr Asn Leu Gly Gly Met Gly Cys Ser Ala Gly Leu Ile Ser
                245                 250                 255
Ile Asp Leu Ala Asn Asn Leu Leu Lys Ala Asn Pro Asn Ser Tyr Ala
            260                 265                 270
Val Val Val Ser Thr Glu Asn Ile Thr Leu Asn Trp Tyr Phe Gly Asn
        275                 280                 285
Asp Arg Ser Met Leu Leu Cys Asn Cys Ile Phe Arg Met Gly Gly Ala
    290                 295                 300
Ala Ile Leu Leu Ser Asn Arg Arg Gln Asp Arg Lys Lys Ser Lys Tyr
305                 310                 315                 320
Ser Leu Val Asn Val Val Arg Thr His Lys Gly Ser Asp Asp Lys Asn
                325                 330                 335
Tyr Asn Cys Val Tyr Gln Lys Glu Asp Glu Arg Gly Thr Ile Gly Val
            340                 345                 350
Ser Leu Ala Arg Glu Leu Met Ser Val Ala Gly Asp Ala Leu Lys Thr
        355                 360                 365
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Asn Ile Thr Thr Leu Gly Pro Met Val Leu Pro Leu Ser Glu Gln Leu
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Met Phe Leu Ile Ser Leu Val Lys Arg Lys Met Phe Lys Leu Lys Val
385                 390                 395                 400
Lys Pro Tyr Ile Pro Asp Phe Lys Leu Ala Phe Glu His Phe Cys Ile
                405                 410                 415
His Ala Gly Gly Arg Ala Val Leu Asp Glu Val Gln Lys Asn Leu Asp
            420                 425                 430
Leu Lys Asp Trp His Met Glu Pro Ser Arg Met Thr Leu His Arg Phe
        435                 440                 445
Gly Asn Thr Ser Ser Ser Ser Leu Trp Tyr Glu Met Ala Tyr Thr Glu
    450                 455                 460
Ala Lys Gly Arg Val Lys Ala Gly Asp Arg Leu Trp Gln Ile Ala Phe
465                 470                 475                 480
Gly Ser Gly Phe Lys Cys Asn Ser Ala Val Trp Lys Ala Leu Arg Pro
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Val Ser Thr Glu Glu Met Thr Gly Asn Ala Trp Ala Gly Ser Ile Asp
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Gln Tyr Pro Val Lys Val Val Gln
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<210> 3
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<212> DNA
<213> Arabidopsis thaliana

<400> 3

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caagatctcc aaaactttta cctctactta caaaacaacc acacatctct aaccatgttc     180
ttcctttacc tcgctctcgg gtcgactctt tacctcatga cccggcccaa acccgtttat     240
ctcgttgact ttagctgcta cctcccaccg tcgcatctca aagccagcac ccagaggatc     300
atgcaacacg taaggcttgt acgagaagca ggcgcgtgga agcaagagtc cgattacttg     360
atggacttct gcgagaagat tctagaacgt tccggtctag gccaagagac gtacgtaccc     420
gaaggtcttc aaactttgcc actacaacag aatttggctg tatcacgtat agagacggag     480
gaagttatta ttggtgcggt cgataatctg tttcgcaaca cgggaataag ccctagtgat     540
ataggtatat tggtggtgaa ttcaagcact tttaatccaa caccttcgct atcaagtatc     600
ttagtgaata agtttaaact tagggataat ataaagagct tgaatcttgg tgggatgggg     660
tgtagcgctg gagtcatcgc tatcgatgcg gctaagagct tgttacaagt tcatagaaac     720
acttatgctc ttgtggtgag cacggagaac atcactcaaa acttgtacat gggtaacaac     780
aaatcaatgt tggttacaaa ctgtttgttc cgtataggtg gggccgcgat tttgctttct     840
aaccggtcta tagatcgtaa acgcgcaaaa tacgagcttg ttcacaccgt gcgggtccat     900
accggagcag atgaccgatc ctatgaatgt gcaactcaag aagaggatga agatggcata     960
gttggggttt ccttgtcaaa gaatctacca atggtagctg caagaaccct aaagatcaat    1020
atcgcaactt tgggtccgct tgttcttccc ataagcgaga agtttcactt ctttgtgagg    1080
ttcgttaaaa agaagtttct caaccccaag ctaaagcatt acattccgga tttcaagctc    1140
gcattcgagc atttctgtat ccatgcgggt ggtagagcgc taattgatga gatggagaag    1200
aatcttcatc taactccact agacgttgag gcttcaagaa tgacattaca caggtttggt    1260
aatacctctt cgagctccat ttggtacgag ttggcttaca cagaagccaa aggaaggatg    1320
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gtttgggtgg ctcttcgtaa cgtcaagcct tctactaata atccttggga acagtgtcta    1440
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<210> 4
<211> 493
<212> PRT
<213> Arabidopsis thaliana

<400> 4

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            20                  25                  30
Val Glu Ala Ser Arg Leu Ser Thr Gln Asp Leu Gln Asn Phe Tyr Leu
        35                  40                  45
Tyr Leu Gln Asn Asn His Thr Ser Leu Thr Met Phe Phe Leu Tyr Leu
    50                  55                  60
Ala Leu Gly Ser Thr Leu Tyr Leu Met Thr Arg Pro Lys Pro Val Tyr
65                  70                  75                  80
Leu Val Asp Phe Ser Cys Tyr Leu Pro Pro Ser His Leu Lys Ala Ser
                85                  90                  95
Thr Gln Arg Ile Met Gln His Val Arg Leu Val Arg Glu Ala Gly Ala
            100                 105                 110
Trp Lys Gln Glu Ser Asp Tyr Leu Met Asp Phe Cys Glu Lys Ile Leu
        115                 120                 125
Glu Arg Ser Gly Leu Gly Gln Glu Thr Tyr Val Pro Glu Gly Leu Gln
    130                 135                 140
Thr Leu Pro Leu Gln Gln Asn Leu Ala Val Ser Arg Ile Glu Thr Glu
145                 150                 155                 160
Glu Val Ile Ile Gly Ala Val Asp Asn Leu Phe Arg Asn Thr Gly Ile
                165                 170                 175
Ser Pro Ser Asp Ile Gly Ile Leu Val Val Asn Ser Ser Thr Phe Asn
            180                 185                 190
Pro Thr Pro Ser Leu Ser Ser Ile Leu Val Asn Lys Phe Lys Leu Arg
        195                 200                 205
Asp Asn Ile Lys Ser Leu Asn Leu Gly Gly Met Gly Cys Ser Ala Gly
    210                 215                 220
Val Ile Ala Ile Asp Ala Ala Lys Ser Leu Leu Gln Val His Arg Asn
225                 230                 235                 240
Thr Tyr Ala Leu Val Val Ser Thr Glu Asn Ile Thr Gln Asn Leu Tyr
                245                 250                 255
Met Gly Asn Asn Lys Ser Met Leu Val Thr Asn Cys Leu Phe Arg Ile
            260                 265                 270
Gly Gly Ala Ala Ile Leu Leu Ser Asn Arg Ser Ile Asp Arg Lys Arg
        275                 280                 285
Ala Lys Tyr Glu Leu Val His Thr Val Arg Val His Thr Gly Ala Asp
    290                 295                 300
Asp Arg Ser Tyr Glu Cys Ala Thr Gln Glu Glu Asp Glu Asp Gly Ile
305                 310                 315                 320
Val Gly Val Ser Leu Ser Lys Asn Leu Pro Met Val Ala Ala Arg Thr
                325                 330                 335
Leu Lys Ile Asn Ile Ala Thr Leu Gly Pro Leu Val Leu Pro Ile Ser
            340                 345                 350
Glu Lys Phe His Phe Phe Val Arg Phe Val Lys Lys Lys Phe Leu Asn
        355                 360                 365
Pro Lys Leu Lys His Tyr Ile Pro Asp Phe Lys Leu Ala Phe Glu His
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```
    370                 375                 380
Phe Cys Ile His Ala Gly Gly Arg Ala Leu Ile Asp Glu Met Glu Lys
385                 390                 395                 400
Asn Leu His Leu Thr Pro Leu Asp Val Glu Ala Ser Arg Met Thr Leu
                405                 410                 415
His Arg Phe Gly Asn Thr Ser Ser Ser Ser Ile Trp Tyr Glu Leu Ala
            420                 425                 430
Tyr Thr Glu Ala Lys Gly Arg Met Thr Lys Gly Asp Arg Ile Trp Gln
        435                 440                 445
Ile Ala Leu Gly Ser Gly Phe Lys Cys Asn Ser Ser Val Trp Val Ala
    450                 455                 460
Leu Arg Asn Val Lys Pro Ser Thr Asn Asn Pro Trp Glu Gln Cys Leu
465                 470                 475                 480
His Lys Tyr Pro Val Glu Ile Asp Ile Asp Leu Lys Glu
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<210> 5
<211> 1512
<212> DNA
<213> Arabidopsis thaliana

<400> 5

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gcaggattag ccatgaaagg atctaagatc aacgtagaag atctccaaaa gttctccctc     180
caccatacac agaacaacct ccaaaccata agccttctat tgtttcttgt cgtttttgtg     240
tggatcctct acatgttaac ccgacctaaa cccgtttacc ttgttgattt ctcctgctac     300
cttccaccgt cgcatctcaa ggtcagtatc caaaccctaa tgggacacgc aagacgtgca     360
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aagattcttg aacgttccgg tcttggtcaa gaaacctaca tccccgaggg tcttcagtgc     480
ttcccacttc agcaaggcat gggtgcttca cgtaaagaga cggaagaagt aatcttcgga     540
gctcttgaca atctttttcg caacaccggt gtaaaacctg atgatatcgg tatattggtg     600
gttgaattcta gcacgtttaa tccaactcca tcactcgcct ccatgattgt gaacaagtac     660
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atagctgttg atgtcgctaa gggattacta caagttcata ggaacactta tgctattgta     780
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ccgttacacg tagaggcgtc aagaatgaca ctacacaggt ttggtaacac ttcttctagc    1320
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atttggcaga ttgctttggg gtcaggtttt aagtgtaaca gttcagtatg ggtggctctg    1440
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<213> Arabidopsis thaliana

<400> 6

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            20                  25                  30
Lys Ile Leu Phe Ile Ser Leu Met Ala Gly Leu Ala Met Lys Gly Ser
        35                  40                  45
Lys Ile Asn Val Glu Asp Leu Gln Lys Phe Ser Leu His His Thr Gln
    50                  55                  60
Asn Asn Leu Gln Thr Ile Ser Leu Leu Leu Phe Leu Val Val Phe Val
65                  70                  75                  80
Trp Ile Leu Tyr Met Leu Thr Arg Pro Lys Pro Val Tyr Leu Val Asp
                85                  90                  95
Phe Ser Cys Tyr Leu Pro Pro Ser His Leu Lys Val Ser Ile Gln Thr
            100                 105                 110
Leu Met Gly His Ala Arg Arg Ala Arg Glu Ala Gly Met Cys Trp Lys
        115                 120                 125
Asn Lys Glu Ser Asp His Leu Val Asp Phe Gln Glu Lys Ile Leu Glu
    130                 135                 140
Arg Ser Gly Leu Gly Gln Glu Thr Tyr Ile Pro Glu Gly Leu Gln Cys
145                 150                 155                 160
Phe Pro Leu Gln Gln Gly Met Gly Ala Ser Arg Lys Glu Thr Glu Glu
                165                 170                 175
Val Ile Phe Gly Ala Leu Asp Asn Leu Phe Arg Asn Thr Gly Val Lys
            180                 185                 190
Pro Asp Asp Ile Gly Ile Leu Val Val Asn Ser Ser Thr Phe Asn Pro
        195                 200                 205
Thr Pro Ser Leu Ala Ser Met Ile Val Asn Lys Tyr Lys Leu Arg Asp
    210                 215                 220
Asn Ile Lys Ser Leu Asn Leu Gly Gly Met Gly Cys Ser Ala Gly Val
225                 230                 235                 240
Ile Ala Val Asp Val Ala Lys Gly Leu Leu Gln Val His Arg Asn Thr
                245                 250                 255
Tyr Ala Ile Val Val Ser Thr Glu Asn Ile Thr Gln Asn Leu Tyr Leu
            260                 265                 270
Gly Lys Asn Lys Ser Met Leu Val Thr Asn Cys Leu Phe Arg Val Gly
        275                 280                 285
Gly Ala Ala Val Leu Leu Ser Asn Arg Ser Arg Asp Arg Asn Arg Ala
    290                 295                 300
Lys Tyr Glu Leu Val His Thr Val Arg Ile His Thr Gly Ser Asp Asp
305                 310                 315                 320
Arg Ser Phe Glu Cys Ala Thr Gln Glu Glu Asp Glu Asp Gly Ile Ile
                325                 330                 335
Gly Val Thr Leu Thr Lys Asn Leu Pro Met Val Ala Ala Arg Thr Leu
            340                 345                 350
Lys Ile Asn Ile Ala Thr Leu Gly Pro Leu Val Leu Pro Leu Lys Glu
        355                 360                 365
Lys Leu Ala Phe Phe Ile Thr Phe Val Lys Lys Lys Tyr Phe Lys Pro
    370                 375                 380
Glu Leu Arg Asn Tyr Thr Pro Asp Phe Lys Leu Ala Phe Glu His Phe
385                 390                 395                 400
Cys Ile His Ala Gly Gly Arg Ala Leu Ile Asp Glu Leu Glu Lys Asn
```

```
                405                 410                 415
Leu Lys Leu Ser Pro Leu His Val Glu Ala Ser Arg Met Thr Leu His
            420                 425                 430
Arg Phe Gly Asn Thr Ser Ser Ser Ser Ile Trp Tyr Glu Leu Ala Tyr
        435                 440                 445
Thr Glu Ala Lys Gly Arg Met Lys Glu Gly Asp Arg Ile Trp Gln Ile
    450                 455                 460
Ala Leu Gly Ser Gly Phe Lys Cys Asn Ser Ser Val Trp Val Ala Leu
465                 470                 475                 480
Arg Asp Val Lys Pro Ser Ala Asn Ser Pro Trp Glu Asp Cys Met Asp
                485                 490                 495
Arg Tyr Pro Val Glu Ile Asp Ile
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<210> 7
<211> 1650
<212> DNA
<213> Arabidopsis thaliana

<400> 7

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gattttcttc agtcggtgaa cttgaagtac gtgaaacttg gttaccacta cctcataaac    180
catgcggttt atttggcgac ataccggtt cttgtgctgg tttttagtgc tgaggttggg    240
agtttaagca gagaagagat ttggaagaag ctttgggact atgatcttgc aactgttatc    300
ggattcttcg gtgtctttgt tttaaccgct tgtgtctact tcatgtctcg tcctcgctct    360
gtttatctta ttgatttcgc ttgttacaag ccctccgatg aacacaaggt gacaaaagaa    420
gagttcatag aactagcgag aaaatcaggg aagttcgacg aagagacact cggtttcaag    480
aagaggatct tacaagcctc aggcataggc gacgagacat acgtcccaag atccatctct    540
tcatcagaaa acataacaac gatgaaagaa ggtcgtgaag aagcctctac agtgatcttt    600
ggagcactag acgaactctt cgagaagaca cgtgtaaaac ctaaagacgt tggtgtcctt    660
gtggttaact gtagcatttt caacccgaca ccgtcgttgt ccgcaatggt gataaaccat    720
tacaagatga gagggaacat acttagttac aaccttggag ggatgggatg ttcggctgga    780
atcatagcta ttgatcttgc tcgtgacatg cttcagtcta accctaatag ttatgctgtt    840
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ggtcctcttg tcctaccttt ctccgagcag cttctcttct ttgctgcttt ggtccgccga   1200
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aaaaccaatg gaatcaagtc ttcctcttcc gatctgtcca agccatacat cccggactac   1320
aagctcgcct tcgagcattt ttgcttccac gcggcaagca aagtagtgct tgaagagctt   1380
caaaagaatc taggcttgag tgaagagaat atggaggctt ctaggatgac acttcacagg   1440
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agtgttcgta gaggcgatag ggtttggcag atcgctttcg gttctggttt taagtgtaac   1560
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<210> 8
<211> 550
<212> PRT
<213> Arabidopsis thaliana

<400> 8

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            20                  25                  30
Val Arg Val Arg Arg Arg Leu Pro Asp Phe Leu Gln Ser Val Asn Leu
        35                  40                  45
Lys Tyr Val Lys Leu Gly Tyr His Tyr Leu Ile Asn His Ala Val Tyr
    50                  55                  60
Leu Ala Thr Ile Pro Val Leu Val Leu Val Phe Ser Ala Glu Val Gly
65                  70                  75                  80
Ser Leu Ser Arg Glu Glu Ile Trp Lys Lys Leu Trp Asp Tyr Asp Leu
                85                  90                  95
Ala Thr Val Ile Gly Phe Phe Gly Val Phe Val Leu Thr Ala Cys Val
            100                 105                 110
Tyr Phe Met Ser Arg Pro Arg Ser Val Tyr Leu Ile Asp Phe Ala Cys
        115                 120                 125
Tyr Lys Pro Ser Asp Glu His Lys Val Thr Lys Glu Glu Phe Ile Glu
    130                 135                 140
Leu Ala Arg Lys Ser Gly Lys Phe Asp Glu Glu Thr Leu Gly Phe Lys
145                 150                 155                 160
Lys Arg Ile Leu Gln Ala Ser Gly Ile Gly Asp Glu Thr Tyr Val Pro
                165                 170                 175
Arg Ser Ile Ser Ser Ser Glu Asn Ile Thr Thr Met Lys Glu Gly Arg
            180                 185                 190
Glu Glu Ala Ser Thr Val Ile Phe Gly Ala Leu Asp Glu Leu Phe Glu
        195                 200                 205
Lys Thr Arg Val Lys Pro Lys Asp Val Gly Val Leu Val Val Asn Cys
    210                 215                 220
Ser Ile Phe Asn Pro Thr Pro Ser Leu Ser Ala Met Val Ile Asn His
225                 230                 235                 240
Tyr Lys Met Arg Gly Asn Ile Leu Ser Tyr Asn Leu Gly Gly Met Gly
                245                 250                 255
Cys Ser Ala Gly Ile Ile Ala Ile Asp Leu Ala Arg Asp Met Leu Gln
            260                 265                 270
Ser Asn Pro Asn Ser Tyr Ala Val Val Val Ser Thr Glu Met Val Gly
        275                 280                 285
Tyr Asn Trp Tyr Val Gly Ser Asp Lys Ser Met Val Ile Pro Asn Cys
    290                 295                 300
Phe Phe Arg Met Gly Cys Ser Ala Val Met Leu Ser Asn Arg Arg Arg
305                 310                 315                 320
Asp Phe Arg His Ala Lys Tyr Arg Leu Glu His Ile Val Arg Thr His
                325                 330                 335
Lys Ala Ala Asp Asp Arg Ser Phe Arg Ser Val Tyr Gln Glu Glu Asp
            340                 345                 350
Glu Gln Gly Phe Lys Gly Leu Lys Ile Ser Arg Asp Leu Met Glu Val
        355                 360                 365
Gly Gly Glu Ala Leu Lys Thr Asn Ile Thr Thr Leu Gly Pro Leu Val
    370                 375                 380
Leu Pro Phe Ser Glu Gln Leu Leu Phe Phe Ala Ala Leu Val Arg Arg
385                 390                 395                 400
Thr Phe Ser Pro Ala Ala Lys Thr Ser Thr Thr Thr Ser Phe Ser Thr
```

```
                405                 410                 415
Ser Ala Thr Ala Lys Thr Asn Gly Ile Lys Ser Ser Ser Asp Leu
            420                 425                 430
Ser Lys Pro Tyr Ile Pro Asp Tyr Lys Leu Ala Phe Glu His Phe Cys
        435                 440                 445
Phe His Ala Ala Ser Lys Val Val Leu Glu Glu Leu Gln Lys Asn Leu
    450                 455                 460
Gly Leu Ser Glu Glu Asn Met Glu Ala Ser Arg Met Thr Leu His Arg
465                 470                 475                 480
Phe Gly Asn Thr Ser Ser Ser Gly Ile Trp Tyr Glu Leu Ala Tyr Met
                485                 490                 495
Glu Ala Lys Glu Ser Val Arg Arg Gly Asp Arg Val Trp Gln Ile Ala
            500                 505                 510
Phe Gly Ser Gly Phe Lys Cys Asn Ser Val Val Trp Lys Ala Met Arg
        515                 520                 525
Lys Val Lys Lys Pro Thr Arg Asn Asn Pro Trp Val Asp Cys Ile Asn
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Arg Tyr Pro Val Pro Leu
545                 550
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<210> 9
<211> 1611
<212> DNA
<213> Arabidopsis thaliana

<400> 9

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cgaacagaga acaacgaaag acgaaagctt cctaatttct tacaaagcgt caacatgaaa    180
tacgtcaagc taggttatca ttacctcatt actcatctct tcaagctctg tttggttcca    240
ttaatggcgg ttttagtcac agagatctct cgattaacaa cagacgatct ttaccagatt    300
tggcttcatc tccaatacaa tctcgttgct ttcatctttc tctctgcttt agctatcttt    360
ggctccaccg tttacatcat gagtcgtccc agatctgttt atctcgttga ttactcttgt    420
tatcttcctc cggagagtct tcaggttaag tatcagaagt ttatggatca ttctaagttg    480
attgaagatt tcaatgagtc atctttagag tttcagagga agattcttga acgttctggt    540
ttaggagaag agacttatct ccctgaagct ttacattgta tccctccgag gcctacgatg    600
atggcggctc gtgaggaatc tgagcaggta atgtttggtg ctcttgataa gcttttcgag    660
aataccaaga ttaaccctag ggatattggt gtgttggttg tgaattgtag cttgtttaat    720
cctacacctt cgttgtcagc tatgattgtt aacaagtata agcttagagg gaatgttaag    780
agttttaacc ttggtggaat ggggtgtagt gctggtgtta tctctatcga tttagctaaa    840
gatatgttgc aagttcatag gaatacttat gctgttgtgg ttagtactga gaacattact    900
cagaattggt attttgggaa taagaaggct atgttgattc cgaattgttt gtttcgtgtt    960
ggtggttcgg cgatttttgtt gtcgaacaag gggaaagatc gtagacggtc taagtataag   1020
cttgttcata ccgttaggac tcataaagga gctgttgaga aggctttcaa ctgtgtttac   1080
caagagcaag atgataatgg gaagaccggg gtttcgttgt cgaaagatct tatggctata   1140
gctggggaag ctcttaaggc gaatatcact actttaggtc ctttggttct tcctataagt   1200
gagcagattc tgtttttcat gactttggtt acgaagaaac tgtttaactc gaagctgaag   1260
ccgtatattc cggatttcaa gcttgcgttt gatcatttct gtatccatgc tggtggtaga   1320
gctgtgattg atgagcttga gaagaatctg cagctttcgc agactcatgt cgaggcatcc   1380
agaatgacac tgcacagatt tggaaacact tcttcgagct cgatttggta tgaactggct   1440
tacatagagg ctaaaggtag gatgaagaaa ggaaaccggg tttggcagat tgcttttgga   1500
agtgggttta agtgtaacag tgcagtttgg gtggctctaa acaatgtcaa gccttcggtt   1560
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<210> 10
<211> 537
<212> PRT
<213> Arabidopsis thaliana

<400> 10

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            20                  25                  30
Val Asn Gly Gly Ser Val Gln Ile Arg Thr Glu Asn Asn Glu Arg Arg
        35                  40                  45
Lys Leu Pro Asn Phe Leu Gln Ser Val Asn Met Lys Tyr Val Lys Leu
    50                  55                  60
Gly Tyr His Tyr Leu Ile Thr His Leu Phe Lys Leu Cys Leu Val Pro
65                  70                  75                  80
Leu Met Ala Val Leu Val Thr Glu Ile Ser Arg Leu Thr Thr Asp Asp
                85                  90                  95
Leu Tyr Gln Ile Trp Leu His Leu Gln Tyr Asn Leu Val Ala Phe Ile
            100                 105                 110
Phe Leu Ser Ala Leu Ala Ile Phe Gly Ser Thr Val Tyr Ile Met Ser
        115                 120                 125
Arg Pro Arg Ser Val Tyr Leu Val Asp Tyr Ser Cys Tyr Leu Pro Pro
    130                 135                 140
Glu Ser Leu Gln Val Lys Tyr Gln Lys Phe Met Asp His Ser Lys Leu
145                 150                 155                 160
Ile Glu Asp Phe Asn Glu Ser Ser Leu Glu Phe Gln Arg Lys Ile Leu
                165                 170                 175
Glu Arg Ser Gly Leu Gly Glu Glu Thr Tyr Leu Pro Glu Ala Leu His
            180                 185                 190
Cys Ile Pro Pro Arg Pro Thr Met Met Ala Ala Arg Glu Glu Ser Glu
        195                 200                 205
Gln Val Met Phe Gly Ala Leu Asp Lys Leu Phe Glu Asn Thr Lys Ile
    210                 215                 220
Asn Pro Arg Asp Ile Gly Val Leu Val Val Asn Cys Ser Leu Phe Asn
225                 230                 235                 240
Pro Thr Pro Ser Leu Ser Ala Met Ile Val Asn Lys Tyr Lys Leu Arg
                245                 250                 255
Gly Asn Val Lys Ser Phe Asn Leu Gly Gly Met Gly Cys Ser Ala Gly
            260                 265                 270
Val Ile Ser Ile Asp Leu Ala Lys Asp Met Leu Gln Val His Arg Asn
        275                 280                 285
Thr Tyr Ala Val Val Val Ser Thr Glu Asn Ile Thr Gln Asn Trp Tyr
    290                 295                 300
Phe Gly Asn Lys Lys Ala Met Leu Ile Pro Asn Cys Leu Phe Arg Val
305                 310                 315                 320
Gly Gly Ser Ala Ile Leu Leu Ser Asn Lys Gly Lys Asp Arg Arg Arg
                325                 330                 335
Ser Lys Tyr Lys Leu Val His Thr Val Arg Thr His Lys Gly Ala Val
            340                 345                 350
Glu Lys Ala Phe Asn Cys Val Tyr Gln Glu Gln Asp Asp Asn Gly Lys
        355                 360                 365
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Thr Gly Val Ser Leu Ser Lys Asp Leu Met Ala Ile Ala Gly Glu Ala
    370                 375                 380
Leu Lys Ala Asn Ile Thr Thr Leu Gly Pro Leu Val Leu Pro Ile Ser
385                 390                 395                 400
Glu Gln Ile Leu Phe Phe Met Thr Leu Val Thr Lys Lys Leu Phe Asn
                405                 410                 415
Ser Lys Leu Lys Pro Tyr Ile Pro Asp Phe Lys Leu Ala Phe Asp His
            420                 425                 430
Phe Cys Ile His Ala Gly Gly Arg Ala Val Ile Asp Glu Leu Glu Lys
        435                 440                 445
Asn Leu Gln Leu Ser Gln Thr His Val Glu Ala Ser Arg Met Thr Leu
    450                 455                 460
His Arg Phe Gly Asn Thr Ser Ser Ser Ser Ile Trp Tyr Glu Leu Ala
465                 470                 475                 480
Tyr Ile Glu Ala Lys Gly Arg Met Lys Lys Gly Asn Arg Val Trp Gln
                485                 490                 495
Ile Ala Phe Gly Ser Gly Phe Lys Cys Asn Ser Ala Val Trp Val Ala
            500                 505                 510
Leu Asn Asn Val Lys Pro Ser Val Ser Ser Pro Trp Glu His Cys Ile
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Asp Arg Tyr Pro Val Lys Leu Asp Phe
    530                 535
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<210> 11
<211> 1502
<212> DNA
<213> Arabidopsis thaliana

<400> 11

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atggctattg tcgccgttga gcttcttcgg atgggtcctg aagagatcct taatgtttgg     180
aattcactcc agtttgacct agttcaggtt ctatgttctt ccttctttgt catcttcatc     240
tccactgttt acttcatgtc caagccacgc accatctacc tcgttgacta ttcttgttac     300
aagccacctg tcacgtgtcg tgtcccctc gcaactttca tggaacactc tcgtttgatc     360
ctcaaggaca agcctaagag cgtcgagttc caaatgagaa tccttgaacg ttctggcctc     420
ggtgaggaga cttgtctccc tccggctatt cattatattc ctcccacacc aaccatggac     480
gcggctagaa gcgaggctca gatggttatc ttcgaggcca tggacgatct tttcaagaaa     540
accggtctta aacctaaaga cgtcgacatc cttatcgtca actgctctct tttctctccc     600
acaccatcgc tctcagctat ggtcatcaac aaatataagc ttaggagtaa tatcaagagc     660
ttcaatcttt cggggatggg ctgcagcgcg ggcctgatct cagttgatct agcccgcgac     720
ttgctccaag ttcatcccaa ttcaaatgca atcatcgtca gcacggagat cataacgcct     780
aattactatc aaggcaacga gagagccatg ttgttaccca attgtctctt ccgcatgggt     840
gcggcagcca tacacatgtc aaaccgccgg tctgaccggt ggcgagccaa atacaagctt     900
tcccacctcg tccggacaca ccgtggcgct gacgacaagt ctttctactg tgtctacgaa     960
caggaagaca aagaaggaca cgttggcatc aacttgtcca aagatctcat ggccatcgcc    1020
ggtgaagccc tcaaggcaaa catcaccaca ataggtcctt tggtcctacc ggcgtcagaa    1080
caacttctct tcctcacgtc cctaatcgga cgtaaaatct tcaacccgaa atggaaacca    1140
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gtgatcgacg agctccaaaa gaatctacaa ctatcaggag aacacgttga ggcctcaaga    1260
atgacactac atcgttttgg taacacgtca tcttcatcgt tatggtacga gcttagctac    1320
atcgagtcta aagggagaat gaggagaggc gatcgcgttt ggcaaatcgc gtttgggagt    1380
ggtttcaagt gtaactctgc cgtgtggaag tgtaaccgta cgattaagac acctaaggac    1440
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<210> 12
<211> 500
<212> PRT
<213> Arabidopsis thaliana

<400> 12

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Leu Ser Phe Leu Leu Ile Pro Ile Met Ala Ile Val Ala Val Glu Leu
35 40 45
Leu Arg Met Gly Pro Glu Glu Ile Leu Asn Val Trp Asn Ser Leu Gln
50 55 60
Phe Asp Leu Val Gln Val Leu Cys Ser Ser Phe Phe Val Ile Phe Ile
65 70 75 80
Ser Thr Val Tyr Phe Met Ser Lys Pro Arg Thr Ile Tyr Leu Val Asp
85 90 95
Tyr Ser Cys Tyr Lys Pro Pro Val Thr Cys Arg Val Pro Phe Ala Thr
100 105 110
Phe Met Glu His Ser Arg Leu Ile Leu Lys Asp Lys Pro Lys Ser Val
115 120 125
Glu Phe Gln Met Arg Ile Leu Glu Arg Ser Gly Leu Gly Glu Glu Thr
130 135 140
Cys Leu Pro Pro Ala Ile His Tyr Ile Pro Pro Thr Pro Thr Met Asp
145 150 155 160
Ala Ala Arg Ser Glu Ala Gln Met Val Ile Phe Glu Ala Met Asp Asp
165 170 175
Leu Phe Lys Lys Thr Gly Leu Lys Pro Lys Asp Val Asp Ile Leu Ile
180 185 190
Val Asn Cys Ser Leu Phe Ser Pro Thr Pro Ser Leu Ser Ala Met Val
195 200 205
Ile Asn Lys Tyr Lys Leu Arg Ser Asn Ile Lys Ser Phe Asn Leu Ser
210 215 220
Gly Met Gly Cys Ser Ala Gly Leu Ile Ser Val Asp Leu Ala Arg Asp
225 230 235 240
Leu Leu Gln Val His Pro Asn Ser Asn Ala Ile Ile Val Ser Thr Glu
245 250 255
Ile Ile Thr Pro Asn Tyr Tyr Gln Gly Asn Glu Arg Ala Met Leu Leu
260 265 270
Pro Asn Cys Leu Phe Arg Met Gly Ala Ala Ala Ile His Met Ser Asn
275 280 285
Arg Arg Ser Asp Arg Trp Arg Ala Lys Tyr Lys Leu Ser His Leu Val
290 295 300
Arg Thr His Arg Gly Ala Asp Asp Lys Ser Phe Tyr Cys Val Tyr Glu
305 310 315 320
Gln Glu Asp Lys Glu Gly His Val Gly Ile Asn Leu Ser Lys Asp Leu
325 330 335
Met Ala Ile Ala Gly Glu Ala Leu Lys Ala Asn Ile Thr Thr Ile Gly
340 345 350

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Pro Leu Val Leu Pro Ala Ser Glu Gln Leu Leu Phe Leu Thr Ser Leu
        355                 360                 365
Ile Gly Arg Lys Ile Phe Asn Pro Lys Trp Lys Pro Tyr Ile Pro Asp
    370                 375                 380
Phe Lys Leu Ala Phe Glu His Phe Cys Ile His Ala Gly Gly Arg Ala
385                 390                 395                 400
Val Ile Asp Glu Leu Gln Lys Asn Leu Gln Leu Ser Gly Glu His Val
                405                 410                 415
Glu Ala Ser Arg Met Thr Leu His Arg Phe Gly Asn Thr Ser Ser Ser
            420                 425                 430
Ser Leu Trp Tyr Glu Leu Ser Tyr Ile Glu Ser Lys Gly Arg Met Arg
        435                 440                 445
Arg Gly Asp Arg Val Trp Gln Ile Ala Phe Gly Ser Gly Phe Lys Cys
    450                 455                 460
Asn Ser Ala Val Trp Lys Cys Asn Arg Thr Ile Lys Thr Pro Lys Asp
465                 470                 475                 480
Gly Pro Trp Ser Asp Cys Ile Asp Arg Tyr Pro Val Phe Ile Pro Glu
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Val Val Lys Leu
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<210> 13
<211> 1548
<212> DNA
<213> Arabidopsis thaliana

<400> 13

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gtgaaattag gttaccatta cttaatctca aatctcttga ctctctgttt attccctctc     180
gccgttgtta tctccgtcga agcctctcag atgaacccag atgatctcaa acagctctgg     240
atccatctac aatacaatct ggttagtatc atcatctgtt cagcgattct agtcttcggg     300
ttaacggttt atgttatgac ccgacctaga cccgtttact tggttgattt ctcttgttat     360
ctcccacctg atcatctcaa agctccttac gctcggttca tggaacattc tagactcacc     420
ggagatttcg atgactctgc tctcgagttt caacgcaaga tccttgagcg ttctggttta     480
ggggaagaca cttatgtccc tgaagctatg cattatgttc caccgagaat ttcaatggct     540
gctgctagag aagaagctga acaagtcatg tttggtgctt tagataacct tttcgctaac     600
actaatgtga aaccaaagga tattggaatc cttgttgtga attgtagtct ctttaatcca     660
actccttcgt tatctgcaat gattgtgaac aagtataagc ttagaggtaa cattagaagc     720
tacaatctag gcggtatggg ttgcagcgcg ggagttatcg ctgtggatct tgctaaagac     780
atgttgttgg tacataggaa cacttatgcg gttgttgttt ctactgagaa cattactcag     840
aattggtatt ttggtaacaa gaaatcgatg ttgataccga actgcttgtt tcgagttggt     900
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gtacatgtag tcaggactca ccgtggagca gatgataaag ctttccgttg tgtttatcaa    1020
gagcaggatg atacagggag aaccggggtt tcgttgtcga aagatctaat ggcgattgca    1080
ggggaaactc tcaaaaccaa tatcactaca ttgggtcctc ttgttctacc gataagtgag    1140
cagattctct tctttatgac tctagttgtg aagaagctct ttaacggtaa agtgaaaccg    1200
tatatcccgg atttcaaact tgctttcgag catttctgta tccatgctgg tggaagagct    1260
gtgatcgatg agttagagaa gaatctgcag ctttcaccag ttcatgtcga ggcttcgagg    1320
atgactcttc atcgatttgg taacacatct tcgagctcca tttggtatga attggcttac    1380
attgaagcga agggaaggat gcgaagaggt aatcgtgttt ggcaaatcgc gttcggaagt    1440
ggatttaaat gtaatagcgc gatttgggaa gcattaaggc atgtgaaacc ttcgaacaac    1500
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<210> 14
<211> 516
<212> PRT
<213> Arabidopsis thaliana

<400> 14

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            20                  25                  30
Leu Gln Ser Val Asn Leu Lys Tyr Val Lys Leu Gly Tyr His Tyr Leu
        35                  40                  45
Ile Ser Asn Leu Leu Thr Leu Cys Leu Phe Pro Leu Ala Val Val Ile
    50                  55                  60
Ser Val Glu Ala Ser Gln Met Asn Pro Asp Asp Leu Lys Gln Leu Trp
65                  70                  75                  80
Ile His Leu Gln Tyr Asn Leu Val Ser Ile Ile Ile Cys Ser Ala Ile
                85                  90                  95
Leu Val Phe Gly Leu Thr Val Tyr Val Met Thr Arg Pro Arg Pro Val
            100                 105                 110
Tyr Leu Val Asp Phe Ser Cys Tyr Leu Pro Pro Asp His Leu Lys Ala
        115                 120                 125
Pro Tyr Ala Arg Phe Met Glu His Ser Arg Leu Thr Gly Asp Phe Asp
    130                 135                 140
Asp Ser Ala Leu Glu Phe Gln Arg Lys Ile Leu Glu Arg Ser Gly Leu
145                 150                 155                 160
Gly Glu Asp Thr Tyr Val Pro Glu Ala Met His Tyr Val Pro Pro Arg
                165                 170                 175
Ile Ser Met Ala Ala Ala Arg Glu Glu Ala Glu Gln Val Met Phe Gly
            180                 185                 190
Ala Leu Asp Asn Leu Phe Ala Asn Thr Asn Val Lys Pro Lys Asp Ile
        195                 200                 205
Gly Ile Leu Val Val Asn Cys Ser Leu Phe Asn Pro Thr Pro Ser Leu
    210                 215                 220
Ser Ala Met Ile Val Asn Lys Tyr Lys Leu Arg Gly Asn Ile Arg Ser
225                 230                 235                 240
Tyr Asn Leu Gly Gly Met Gly Cys Ser Ala Gly Val Ile Ala Val Asp
                245                 250                 255
Leu Ala Lys Asp Met Leu Leu Val His Arg Asn Thr Tyr Ala Val Val
            260                 265                 270
Val Ser Thr Glu Asn Ile Thr Gln Asn Trp Tyr Phe Gly Asn Lys Lys
        275                 280                 285
Ser Met Leu Ile Pro Asn Cys Leu Phe Arg Val Gly Gly Ser Ala Val
    290                 295                 300
Leu Leu Ser Asn Lys Ser Arg Asp Lys Arg Arg Ser Lys Tyr Arg Leu
305                 310                 315                 320
Val His Val Val Arg Thr His Arg Gly Ala Asp Asp Lys Ala Phe Arg
                325                 330                 335
Cys Val Tyr Gln Glu Gln Asp Asp Thr Gly Arg Thr Gly Val Ser Leu
            340                 345                 350
Ser Lys Asp Leu Met Ala Ile Ala Gly Glu Thr Leu Lys Thr Asn Ile
        355                 360                 365
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Thr Thr Leu Gly Pro Leu Val Leu Pro Ile Ser Glu Gln Ile Leu Phe
    370                 375                 380
Phe Met Thr Leu Val Val Lys Lys Leu Phe Asn Gly Lys Val Lys Pro
385                 390                 395                 400
Tyr Ile Pro Asp Phe Lys Leu Ala Phe Glu His Phe Cys Ile His Ala
                405                 410                 415
Gly Gly Arg Ala Val Ile Asp Glu Leu Glu Lys Asn Leu Gln Leu Ser
            420                 425                 430
Pro Val His Val Glu Ala Ser Arg Met Thr Leu His Arg Phe Gly Asn
        435                 440                 445
Thr Ser Ser Ser Ser Ile Trp Tyr Glu Leu Ala Tyr Ile Glu Ala Lys
    450                 455                 460
Gly Arg Met Arg Arg Gly Asn Arg Val Trp Gln Ile Ala Phe Gly Ser
465                 470                 475                 480
Gly Phe Lys Cys Asn Ser Ala Ile Trp Glu Ala Leu Arg His Val Lys
                485                 490                 495
Pro Ser Asn Asn Ser Pro Trp Glu Asp Cys Ile Asp Lys Tyr Pro Val
            500                 505                 510
Thr Leu Ser Tyr
        515
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<220>
<223> Primer

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<210> 16
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> Primer

<400> 16
ctcgagttag gaccgaccgt tttg 24

<210> 17
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> Primer

<400> 17
ctcgagcaag tccactacca cgca 24

<210> 18
<211> 24
<212> DNA
<213> Artificial Sequence

<220>
<223> Primer

<400> 18
ctcgagcgag tcagaaggaa caaa 24

<210> 19
<211> 23
<212> DNA
<213> Artificial Sequence

<220>
<223> Primer

<400> 19
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<210> 20
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> Primer

<400> 20
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<210> 21
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> Primer

<400> 21
cagttcctca aacgaagcta 20

<210> 22
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> Primer

<400> 22
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